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‘A rattling good experience’: the development of children’s thinking in design and technology lessons in English and Finnish primary schools

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Abstract
The purpose of the project, and resultant study reported herein, was to provide insights into the development of children’s learning within the design and technology curriculum. The study was based on the assumption that constructivistic driven, open-ended problem solving and pupil centred approaches are especially suitable for design and technology education.

This study aims to reveal what kind of thinking occurred in children during a project which involved designing, making and using ‘rattles’. It demonstrates what the outcome of this thinking was, with respect to children’s learning about designing their unique version of a rattle. The context and purpose of a rattle is seen as a vital component of the information worked upon by children. This is an analysis of what the children intended their rattles to do, with respect to the design of components, which, when assembled, form a whole rattle.

Creating a rattle is concerned with both the ‘means - ends in view’ thinking, as the product is designed and made, and the holistic purpose of the artefact in a socio-cultural setting. Such a teaching approach provides many opportunities for children to interact with design problems and other people, especially their peers.

Introduction
The purpose of the project is to provide insights into the development of children’s learning within the design and technology curriculum. The study was based on the assumption that constructivistic driven, open-ended problem solving and pupil centred approaches are especially suitable for design and technology education.

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Theory
According to constructivist theory, learning is an active, continuous process whereby the learner takes information from the environment and constructs personal interpretations and meanings based on prior knowledge and experience (von Glasersfeld, 1995). Personal interests and needs that arise from the learner have a great influence on the learning process. A variation on this theory sees learning as a social phenomenon which is mediated through social interactions among the members of the learning community as they engage in the learning activity (Konold, 1995; Rogoff, 1990; Vygotsky, 1986). Knowledge is seen to be social in nature. It is shared through the members of the learning community by meanings of context dependent language (Gergen, 1995; Bjorkvist, 1994) and often in apprenticeship-like situations (Rogoff, 1990:141).

While there is a well established design and technology National Curriculum in the UK, Finland is in the early stages of developing its technology curriculum.

The study itself
The study uses the trial Nuffield Primary Design and Technology Project materials (Twyford, 1997) in a UK and a Finnish context. The design and technology work carried out by the teachers and pupils was concerned with pupils developing their capabilities to design, make and use a product, to be made in
resistant materials, which used sound or noise for a purpose to be designated by the pupil. In the UK school the notion of designing a ‘rattle’ signified the work, whereas in Finland the broader aspect of using sound carried the work forward, although the idea of a rattle did figure in the work.

The Finnish context
In Finland the ‘rattle-material’ was introduced to Vattukyla Primary school, located in the township of Haapavesi, Finland. The head teacher, Risto Klasila, agreed to apply open-ended teaching approaches to the experiment. This approach assumes that pupils already possess quite a large variety of relevant experiences and knowledge for use in technological problem solving.

The Finnish design brief
The teacher presented an open-ended design problem to the pupils, saying:

“You have to create a mechanical device, which makes a loud noise for a given purpose, and the construction should be easy enough to use by only one hand.”

At this point in the project the pupils were given time to think and plan their own design ideas.

During the second day the whole class visited a local museum to see a collection of traditional Finnish rattles, especially those which have been used in hare hunting. The purpose of these rattles was discussed and it was emphasised that a hare rattle had a particular and practical, context-specific authentic use (see Honebein et al, 1992).

The UK context
The project at White Rock Primary school was developed according to the following brief: The big task: in this children will design, make and use a rattle to show their support for a favourite sport or particular event. They will be required to show when it is appropriate to make a noise using a rattle and when it is not.

Research method
Constructivism aims to understand the meanings constructed by pupils taking part in context-specific and socially situated activity through social interaction (Schwandt, 1994). This required the researchers to take into account social interaction between the group members as well as the context and substance of social interaction in being technological.

The study involved direct observations of the pupils in action and employed a search for how children brought their previous experiences to the making of the sound producing device. (Patton, 1990) Data were collected by means of videotaped recordings of the project, the teacher’s written report of the project, photographs of the pupils’ final outcomes and a questionnaire where the pupils were asked to answer the following questions:

i What did you make? Could you describe it?
ii Why did you make it?
iii Where did you get your ideas from?

Results
During the first viewing of the data it was clear that the pupils brought a great deal of their personal experience to their work. The inductive, interpretative analysis used in this study enabled the results to be framed as empirical assertions, with data as ‘evidentiary warrants’ (Erickson, 1986: 145). Thus results are presented through three assertions supported by examples taken from data sources. Examples were also micro-analysed (comment) and ‘squeezed’ as far as the research problems were concerned in order to clarify the interpretative analysis process, which, consequently led to more general assertions (Jarvinen, 1998).

Assertion 1
It was clear that while working, the pupils made connections to their earlier experiences, knowledge and information and applied their already constructed knowledge to the making of a sound producing device.

When the pupils, at Vattukyla school, were asked where they found their design ideas from, one boy answered, that:

“There is a corrugated panel placed in the walls of corridor. Once, I ran a wooden
ice-cream stick on it and found out that I was able to produce a kind of rattle sound. When the teacher introduced the project to us I decided to apply that ‘panel-experience’ and cut out a piece out of the panel and placed a string in it. In this way one can carry it around one’s neck.”

Comment
The boy can be interpreted as acting like a technologist, because he applies his previous experiences, knowledge and skills to a new problem-solving situation. Nobody told him to use his previous experiences with the panel in this project. The outcome was totally due to his own reasoning. It was used in a real hare hunting experience.

After the project, four boys were found in the wood shop making the biggest rattle in the world! It was their own idea and when asked about the origin of the idea one boy answered:

“Somebody has made a wooden cycle and its rear fork was in the wood shop storage. I saw it and noticed that it somehow represented the construction of a rattle. It was from seeing this that I got an idea to make a huge rattle.”

Comment
It this example the boy didn’t begin with the idea of making the huge rattle beforehand. When he saw the bicycle fork, his mind was ‘triggered’ to make a connection between the shapes and form which he saw in the forks and the design of a conventional rattle. He instantly carried the shape of the fork to the structure of the rattle. Now, in one moment, he connected his previous knowledge to the object seen in the storage.

Further, pupils at White Rock school were asked to draw out an idea for a rattle, which they could make from a free choice of materials. When the pupils were asked to describe how they made a ‘rattle’ ideal for a special purpose one girl wrote generally about how her rattle was made to work to make a certain noise, as well as to look attractive.

“In the designing and making of a rattle for a special purpose, I will use different shaped beads so that it looks attractive; the beads can slide up and down; stoppers to stop beads coming off; discs at the ends to make an extra noise; soft and smooth handle so that it doesn’t hurt hands; ends are full of beads”

Comment
The intention behind the pupils’ work was clearly focused upon using a range of materials to make certain noises. Pupils intuitively devised pleasing arrangements of coloured beads and cotton reels to form a noise. Their previous experience of arrangements of objects in colourful patterns dominated this task. But so did making a noise!

When making a rattle the pupils were required to read drawings which showed examples of typical components from which they could form or modify a traditional rattle to their own design.

Comment
The constant interaction between individuals and teachers within the group was characterised by discussion about how things are best made and how they fit together. This social interaction clearly reinforced individual learning.

Pupils were naturally challenged to interact with each other as members of an established class of peers. They also clearly and enthusiastically worked together on the design problems. They used all their experience: to acquire the skills to fashion components; to prototype the assembly of the rattle to ensure a correct fit and to realise that decoration was best done before final assembly.

In the manufacture of the rattle, pupils knew intuitively how to shape components to fit them together so that they functioned well. They demonstrated that they needed to work the materials to create tolerances in the operation of the components in a working rattle. They worked to make components stay in place but also to work one with the another.

Assertion 2
Although the pupils were observed to have worked creatively and openly, their final outcomes were nevertheless exactly consistent with the defined problem.
Vattukyla pupils took part in a real hare hunt. “Hunters are waiting in a forest clearing. In the distance, there can be heard a cacophony of different noises. First it is faint; then increases in volume. The pupils are driving through the forest to frighten hares towards the hunters. Every pupil used their device to make a loud noise.”

Comment
It is evident that every solution is effective enough to make a loud noise to startle a hare. Different kinds of sounds exemplify the different solutions to the problem of driving animals in a hunt.

Before making the ‘rattles’ at White Rock pupils were asked to describe where making a noise is acceptable and where not. They identified that people cheer on their favourite team by using rattles, and that traditional football supporters used them. Children discussed why people need to make a loud noise to support a team.

Thus, knowing a real use for a sound device enhanced pupils’ understanding of the product. The discussion enabled them to create their own artefact.

Comment
Pupils commented that people cheer on their teams to do well and to win the match or game. When invited to use their rattles to show that they worked they made a tremendous excited noise! Pupils knew only too well the purpose of making a loud noise - for the pleasure of doing it!

Assertion 3
The pupils interacted in a social setting and formulated their ideas together, which were then individually used to complete a personal design.

At Vattukyla, five girls explained that they worked on an idea given by their teacher and then developed it further by working together. They all made different shaped wooden battens, with strings attached to the top. At the ends of the thongs were wooden beads. They produced individually a variety of designs.

Some pupils needed help to begin their design work. Despite this, the pupils can be interpreted as working on a relatively broad platform. This is evident in the variety of different outcomes.

Discussion
This study supports the notion that social interaction promotes learning in and through designing and technological problem solving. The pupils learned from themselves in an interactive socio-cultural setting. Knowledge transfer from the pupils’ previous experiences into their project was useful, significant and provided a meaningful basis from which they could make their designing decisions and begin their design decisions and begin their manufacture of a ‘rattle’.

Thoughtful design and technological experiences involve pupils in using their own language to reflect, converse and form and test theories. Generally pupils may learn through design and technology by simply experiencing creating things or by being directed to do so, but it is a vital task of teachers to provide children with effective experiences from which they can ‘grow’ technologically. It is vital that pupils are given opportunities to do things without any set answers in design and technology, because this is in the nature of ‘being technological’.

Designing operates through a sense of user orientation to a product. Pupils should explore the usefulness and function of a device, including knowing about the subject matter concerning the purpose of the artefact (Morrison & Twyford, 1994). Thus the example of a ‘rattle’ has many possibilities for cultural understanding, as well as technical achievement.

Conclusion
Children’s ideas can be firmly held. Most of their ideas are sensible, plausible and useful to them, within their experience. If experiences are encountered which are in conflict with these ideas, then children may feel the limited acceptance of their ideas. It is not enough to show children examples which conflict with their ideas. There should
be time allowed for an interaction between being shown more forceful propositions and the construction and reconstruct their ideas for themselves.

It is vital that children are encouraged to become interested in the explanations which their classmates may give. Knowing how to respect the views of others is part of learning in technology.

According to the most radical view of constructivism (von Glasersfeld, 1993; Schwandt, 1994) there is no reality that exists outside the individual; it is considered necessary to perceive and experience the outside world personally in order to formulate it as individual reality. In a socio-cultural interpretation this takes place in interaction with the social environment and the knowledge is commonly shared. This theoretical perspective suggests that there would not be a technological reality around us if we had not, literally, constructed it. Epistemologically it is a human construction. Technological development has usually been driven by individual or social needs to sustain living and to make it easier or safer (Hacker & Barden, 1988) or for other purposes that seem important. According to results of this study the socio-cultural constructivist approach appears to be natural and effective in organising learning.

When participating in the project, the pupils were actors in the process where they constructed a personally authentic technological reality on the basis of socio-cultural needs (In Finland their ideas relate to hunting hares; in UK they relate to supporting a team) and personal ideas.

Designing and making things is a form of reflective thinking in which the pupil interacts with many sources of knowledge in the process of solving the problem. The pupil’s mind changes and develops through active participation. In turn pupils are able to cause changes in the world around them when the problems tackled are real.

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